Canada Alberta

FOREST RESOURCE DEVELOPMENT AGREEMENT
ENTENTE SUR LA MISE EN VALEUR DES RESSOURCES FORESTIERES

Canada Alberta

The Canada-Alberta Forest Resource Development Agreement is a subsidiary agreement of the Canada-Alberta Economic and Regional Development Agreement, which provides coordination and cooperation between the governments of Alberta and Canada in areas of Alberta's economic development.

The Canada-Alberta Forest Resource Development Agreement is funded equally by the governments of Canada and Alberta, from April 1, 1984, to March 31, 1989.

Its primary objectives are to ensure the long-term availability of timber supplies; to optimize timber uses; and to contribute to the growth and diversification of Alberta's economy.

The Agreement comprises three programs: Reforestation; Applied research, technology transfer and opportunity identification; and Public information, evaluation and administration. These programs are managed by a joint Directorate and are implemented by the Canadian Forestry Service and the Alberta Forest Service.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est auxiliaire à l'Entente Canada-Alberta sur le développement économique et régional, qui vise à assurer la coordination et la coopération des deux gouvernements relativement au développement économique de l'Alberta.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est financée à parts égales par les gouvernements du Canada et de l'Alberta, et a cours du 1er avril 1984 au 31 mars 1989.

Ses objectifs principaux sont assurer la disponibilité à long terme de réserves de bois; optimiser leur utilisation; et contribuer à la croissance et la diversification de l'économie de la province.

L'Entente comprend trois programmes: Reboisement; Recherche appliquée, transferts de connaissances techniques et relevé des occasions; et Information, évaluation et administration. Ces programmes sont gérés par un Bureau de direction conjoint, et mis en oeuvre par le Service canadien des forêts et le Service forestier de l'Alberta.

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INTERIM PROGRESS REPORT

TREE IMPROVEMENT APPLIED RESEARCH AND TECHNOLOGY TRANSFER

Alberta Forest Service*
1987

Genetics Section
Reforestation and Reclamation Branch

This is a joint publication of the Canadian Forestry Service and the Alberta Forest Service pursuant to the Canada/Alberta Forest Resource Agreement.

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ABSTRACT

The C.A.F.R.D.A. (Canada-Alberta Forest Resource Development Agreement) tree improvement project was started in April 1986 with a four year term. The objective of the project is to expand and accelerate work on the provincial genetics and tree improvement program in order to enhance yield, wood quality and pest resistance of future forest plantings in Alberta. This report provides an interim progress report on the project activities and accomplishments during the period April 1, 1986 through November 30, 1987. Only the increased portion of the work accomplished on the provincial genetics and tree improvement program due to C.A.F.R.D.A. funding is described. This work included: (1) field selection and wood quality evaluations of 74 superior trees for two genetic improvement projects; (2) establishment of 10 new research plantations on species, provenance and genetic testing topics, and carrying out intensive investigations on three flowering and seed production studies; (3) planning and implementing a rare and exceptional stands survey; (4) site developments for seven new experimental areas; (5) a substantially increased plant propagation, seed technology and technical support program to meet requirements of the expanded tree improvement program. Future plans for the remaining duration of C.A.F.R.D.A. on these and related work activities are outlined. The report also presents a preliminary summary of selected research results to highlight some interesting and noteworthy findings.

ACKNOWLEDGEMENTS

The work described in this report is collective effort of many individuals. Although almost all the work described here was carried out by the Alberta Forest Service staff, significant assistance was provided by the Alberta Department of Agriculture and B.C. Ministry of Forests and Lands which is gratefully acknowledged. Sincere appreciation and credit is due following staff of the Alberta Forest Service for their contributions to the project:

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1.0 BACKGROUND

Work on the provincial tree improvement program in Alberta was started in 1976 by the Alberta Forest Service as part of an overall plan to move towards intensive forest management in order to enhance yield and quality of the future forest. It is well established that the yield, hardiness and wood quality of forest trees can be substantially increased by developing genetically superior strains of seed and their use in reforestation. Large practical benefits are already being realized in many parts of the world where tree improvement is more advanced than in Alberta.

Following the start of the tree improvement program in Aberta in 1976, considerable time was spent on defining the long term nature, general direction and technical plans for the work program. Laboratory and greenhouse facilities for tree improvement were separately developed at the Pine Ridge Forest Nursery in 1979. These facilities were further expanded in 1984 in preparation for anticipated increases in the program work. Over this period cooperative working arrangements were also developed with the FMA forest industry, which currently participates in several projects and assists with the work.

At the commencement of the Canada-Alberta Forest Resource Development Agreement (C.A.F.R.D.A.) in 1985, the tree improvement program was in its ninth year of operation. Even though considerable progress had been made during this period, the work could still only be characterized to be in its early development stages. Furthermore, there were several projects on which work had been planned but could not be started because of lack of resources. It was considered to be highly beneficial to expand efforts of the ongoing tree improvement program and speed up work so that improvements in yield and timber quality could be realized from Alberta's forests starting at an earlier date. In recognition of these needs, the present project "Tree Improvement Applied Research and Technology Transfer" was approved by the C.A.F.R.D.A. Directorate for four years duration (1986/87 through 1989/90).

2.0 PROJECT OBJECTIVE

The objective of the project is to expand and accelerate work on the provincial genetics and tree improvement program in order to enhance yield, wood quality and pest resistance of future forest plantings in Alberta.

The tree improvement program of the Alberta Forest Service is an integrated research and development effort with province-wide scope. It addresses the needs of providing improved seed for reforestation and developing required scientific knowledge and technology for operational tree improvement. The purpose of C.A.F.R.D.A. tree improvement funding is to facilitate accomplishment of considerable amount of additional work in this area by supplementing A.F.S. resources.

3.0 PROGRESS REPORT AND FUTURE WORK PLANS

The work being carried out as part of the C.A.F.R.D.A. tree improvement project consists of enhancements to the provincial genetics and tree improvement program. For planning and reporting purposes this work has been organized into five activity areas. These are:

1. Field selection of superior trees and wood quality evaluations
2. Research and demonstration trials
3. Survey and evaluation of rare and exceptional stands
4. Experimental areas development
5. Plant propagation, seed technology and technical support.

Progress report for these activities, covering the period April 1, 1986 through November 30, 1987, is presented in the following sections along with a brief explanation of the purpose of each activity and future work plans for the remainder of the project duration. In selected instances, where data have already been summarized, research results are briefly presented to highlight interesting or noteworthy findings.

3.1 Field Selection of Superior Trees and Wood Quality Evaluation

The purpose of this activity is to locate and document superior trees to provide material for various genetic improvement projects. Once trees have been selected, scions are collected from these for grafting and establishing these in seed orchards. In addition wood samples are collected from individual trees to evaluate and document their wood quality. Finally, cones are collected from each to provide seed for genetic testing in field trials to identify true genetic worth of individual trees so that already established seed orchards can be rogued of inferior genetic stock to enhance genetic improvement of the seed produced.

The overall genetics and tree improvement program entails nine genetic improvement projects (five in white spruce and four in lodgepole pine). In addition a minor genetic improvement project was recently planned for Douglas-fir. Superior trees selection for many of these projects has been ongoing since 1976 and a large number of trees (approximately 1400) had already been selected prior to commencement of C.A.F.R.D.A.

As part of C.A.F.R.D.A. work, it was decided to carry out tree selections and related work for two genetic improvement projects. The first project deals with genetic improvement of white spruce for the Lac La Biche area which is identified as breeding region "E". The second project is the newly established Douglas-fir genetic improvement project for the Bow/Crow Forest. Progress on these along with a preliminary summary of results on wood quality analyses and future work plans are discussed below.

3.1.1 White Spruce Project

During 1986 and 1987 a total of 48 superior white spruce trees were selected by cruising forest stands in the Lac La Biche Forest. Thirty-one trees were selected in 1986 and the remaining in 1987. Field work for 1987/88 is still ongoing. An illustration of a superior white spruce tree is shown in Figure 1a.

Scion collection and grafting of all 31 trees selected in 1986 is complete. Field data on these trees have been fully compiled and documentation completed. Cones have also been collected from 10 trees that were found to have cone crop in 1987. Wood quality analyses (relative density[1] and fibre length) have been completed for wood samples collected from 30 trees. Results are presented in Table 1 and figures 2a, 2b. Overall average relative density of the trees examined was found to be 0.350, with a range from 0.302 to 0.395. Overall average fibre length for the 30 trees was found to be 2.85 mm with a range from 2.34 to 3.13. Variation of relative wood density within individual tree wood samples was also investigated by subdividing the samples in juvenile wood (rings 1-20), intermediate wood (rings 21-50) and mature wood (ring 51 onwards) portions. Overall average relative density for the three types of wood samples was found to be 0.341, 0.347 and 0.364 respectively. Similarly, average fibre length for the juvenile wood (rings 17-20) and mature wood (rings 47-50) was also investigated for all trees and found to be 2.38 mm and 3.18 mm respectively.

Future work plan for white spruce superior trees selection and related work is as follows:

- -- Select and document 20-30 additional trees in the Lac La Biche Forest and adjoining area to the north in the Athabasca Forest
- -- Complete scions collection and grafting for all remaining trees
- -- Complete cone collections from all remaining trees
- -- Complete wood quality analyses for all remaining trees

[1] Expressed as ratio of oven-dry weight and green volume of wood sample.

FIGURE 1 — ILLUSTRATIONS OF SUPERIOR WHITE SPRUCE AND DOUGLAS—FIR PARENT TREES.

Figure 1a – Superior white spruce tree.

Figure 1b – Superior Douglas-fir tree.

Table 1. Average relative densities (RD) and fibre lengths (FL) for the 30 White Spruce selections from Lac La Biche.

Ortet #	Average RD	Average FL (mm)
441	0.363	2.64
442	0.395	2.75
443	0.354	2.67
444	0.387	2.92
445	0.353	2.81
446	0.337	3.16
447	0.341	3.03
448	0.375	2.78
449	0.372	2.68
450	0.322	2.34
451	0.325	2.79
452	0.336	2.80
453	0.366	3.11
454	0.341	2.97
455	0.304	2.69
456	0.350	2.79
457	0.302	2.86
458	0.374	2.82
459	0.355	2.93
460	0.321	3.3
461	0.322	2.54
462	0.355	2.72
463	0.347	3.13
464	0.360	2.88
465	0.337	2.71
466	0.391	3.05
467	0.345	2.90
468	0.317	2.88
469	0.376	3.04
523	0.364	2.94

FIGURE 2 — WOOD QUALITY CHARACTERISTICS OF WHITE SPRUCE AND DOUGLAS—FIR.

Figure 2a – Distribution of relative densities for 30 white spruce superior trees selected in Lac La Biche Forest.

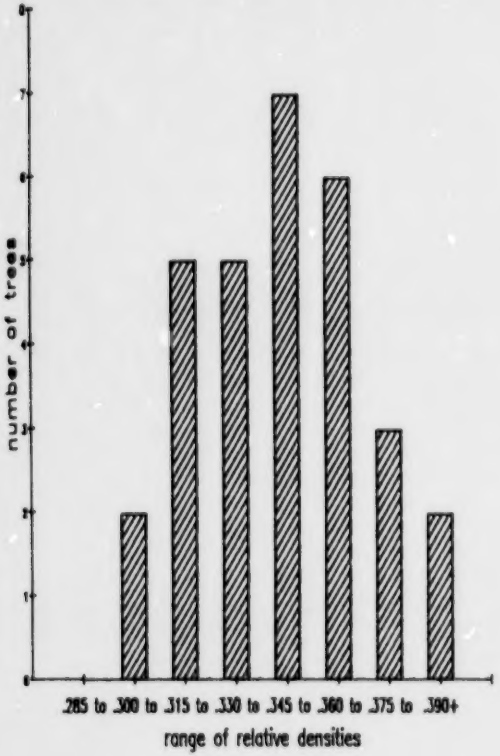


Figure 2b – Distribution of average fibre length for 30 white spruce superior trees selected in Lac La Biche Forest.

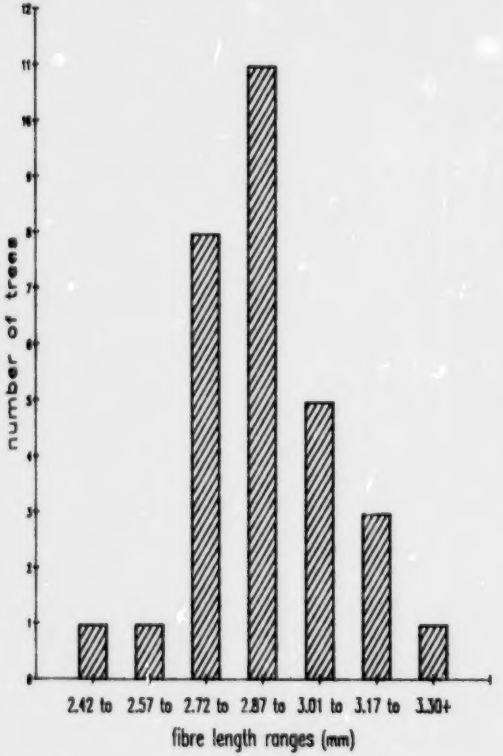
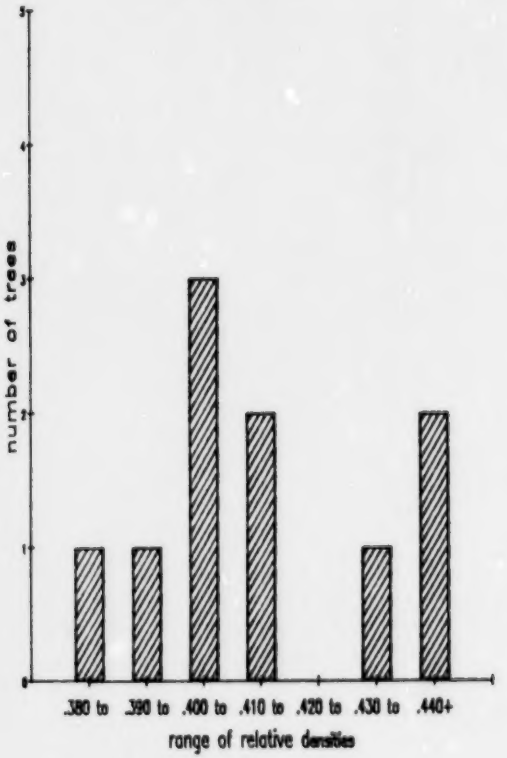


Figure 2c – Distribution of relative densities for 10 Douglas-fir superior trees selected in Bow/Crow Forest.



3.1.2 Douglas-fir Project

A total of 26 superior Douglas-fir trees have been selected by cruising promising stands located in the Bow/Crow Forest. Field data on individual trees have been compiled and related documentation is in progress. An illustration of a superior Douglas-fir tree is shown in Figure 1b.

Scions have already been collected from six trees and grafting is ongoing. Wood samples collected from 10 trees have been analysed for relative wood density and results are shown in Table 2 and Figure 2c. Overall average relative density of the ten trees was found to be 0.415, with a range from 0.386 to 0.450.

TABLE 2

Average relative densities (RD) for 10 Douglas-fir selections from Bow/Crow

Tree #	Average RD
FD #1	0.416
FD #2	0.416
FD #3	0.405
FD #4	0.396
FD #5	0.406
FD #6	0.451
FD #7	0.445
FD #8	0.386
FD #9	0.401
FD #10	0.432

Future work plan for Douglas-fir superior trees selection and related work is as follows:

- Complete documentation on already selected trees and select six more trees in the Bow/Crow Forest
- Complete scions collection and grafting for all remaining trees
- Complete wood quality analyses for all remaining trees

3.2 Research and Demonstration Trials

The purpose of this activity is to carry out field and laboratory research to develop new information and techniques for application in practical tree improvement in Alberta. In addition a small program is being developed for field demonstrations to inform general public about the provincial tree improvement program. The work program under this activity is subdivided in four areas, which are: (1) species and provenance trials, (2) Genetic testing field trials, (3) seed production research trials, and (4) Demonstration trials. Progress and future plans for each of these are described below.

3.2.1 Species and Provenance Trials

The objective of species testing work is to identify more suitable species for reforestation in Alberta, in addition to white spruce and lodgepole pine which are the traditional reforestation species. The main objective of provenance research trials is to determine tolerance limits for geographic movement of seed sources of white spruce, black spruce, tamarack and lodgepole-jack pine. Prior to the commencement of C.A.F.R.D.A., a large number of research plantation had already been established throughout Alberta. These included an extensive series of white spruce provenance trials.

As part of C.A.F.R.D.A. tree improvement project, it was decided to establish a province-wide network of black spruce, tamarack, and lodgepole-jack pine plantings. Four field trials of lodgepole-jack pine had already been established in 1985, but the remaining trials were assigned to be completed as part of C.A.F.R.D.A. work.

During 1986 and 1987, a total of six field trials were established and related documentation and establishment reports completed. Particulars of these trials are briefly described below:

TAMARACK PROVENANCE TRIALS (EXPERIMENT G136)

- Four field trials established at following locations:
  - Pine Ridge Forest Nursery (Experiment G136A)
  - Swartz Creek Experimental area in Edson Forest (Experiment G136B).
  - Mitsue South Experimental Area in Slave Lake Forest (Experiment G136C)
  - Hay River Experimental Area in Footner Lake Forest (Experiment G136D)
- Experimental design for the field trials consisted of randomized complete block design with 5 replications and 4-8 tree row plots. The number of seedlots among trials varies from 20-25, which includes 2 Siberian larch seedlots that were added for comparison purposes.

-- Planting spacing was 2.5 x 2.5 m at all locations except Pine Ridge Forest Nursery where planting spacing was 3 x 3 m.
-- Total number of trees planted at any location varied from 460-860 and the size of area outplanted ranged from 0.3 hectare to 0.8 hectare.

LODGEPOLE-JACK PINE SPECIES, 'OUTLIER' AND HYBRID POPULATIONS TEST (EXPERIMENT G 134)

-- Two field trials were established at the following locations:
  -- Hangingstone Experimental Area in Athabasca Forest (Experiment G134E)
  -- Mistsue South Experimental Area in Slave Lake Forest (Experiment G134F)
-- Experimental design for the field trials consisted of randomized complete block design with 5 replications and 4-8 tree row plots. The number of seedlots among trials varies from 20-25, which includes 2 Siberian larch seedlots that were added for comparison purposes.
-- Planting spacing at both planting locations was 2.5 x 2.5 m. The area outplanted in each trial was approximately 0.5 hectare.

In addition to the field trials described above, a total of three tamarack and three black spruce provenance trials were established in the nursery beds at Pine Ridge Forest Nursery. These will be outplanted at various locations throughout the province during 1988 and 1989.

Future work plan for species and provenance trials, as part of C.A.F.R.D.A. project, consists of maintaining and tending already established plantings, and to complete field outplanting of the trials that are at present in nursery stock production stage. In addition a series of trials are planned to be established to test performance of Douglas-fir on drought prone sites in the montane forest region.

3.2.2 Genetic Testing Field Trials

The objective of genetic testing field trials is to evaluate genetic worth of open-pollinated seedlots or progenies collected from superior trees selected in the wild forests and propagated for various genetic improvement projects. Based on periodic results of these trials, roguings are carried out in already established seed orchards. These roguings progressively cull out inferior genetic stock and increase the level of genetic improvement that can be realized from seed orchards.

Prior to commencement of C.A.F.R.D.A., eight large genetic test plantations of lodgepole pine had already been established in west central

Alberta. Extension of this work to white spruce was made possible by C.A.F.R.D.A. funding. Four field trials were established as part of this work. These trials correspond to genetic improvement of white spruce for breeding region "D". Each trial contained open pollinated progenies or half-sib seedlots from 144-150 superior trees selected in region "D" area during 1976-1979. Nursery stock production for these trials was started in 1983, prior to commencement of C.A.F.R.D.A. However the field outplantings of these trials was carried out in 1986 as part of C.A.F.R.D.A. work, and related documentation and establishment reports completed. Some further details of these trials are given below:

- -- Title of the trials is: Half-sib family testing for breeding region "D" (Experiment G132)
- -- Trials are established at following locations:
  - -- Calling Lake Experimental Area in the Lac La Biche Forest (Experiment G132A)
  - -- Mitsue South Experimental Area in the Slave Lake Forest (Experiment G132B)
  - -- Red Earth Experimental Area in the Slave Lake Forest (Experiment G132C)
  - -- Carson Lake Experimental Area in the Whitecourt Forest (Experiment G132D)
- -- Experimental design for the field trials consists of randomized complete block design with six replications and five or six tree-row plots. Number of seedlots in individual trials varies from 146-150.
- -- Planting spacing was 2.5 x 2.5 m at all locations. The area outplanted in each trial varied from 2.8-3.5 hectares.

Future work plan for genetic testing field trials, as part of C.A.F.R.D.A. project, consists of maintaining and tending the four trials described above. In addition at least one more field trial is planned to be established in 1988.

3.2.3 Seed Production Research Trials

Prior to the commencement of C.A.F.R.D.A., several seed production research trials were established by the Alberta Forest Service to develop much needed technical information for seed orchard planning, and to develop practical prescriptions to enhance flowering, seed production and seed quality of white spruce and lodgepole pine. With the start of C.A.F.R.D.A. tree improvement project in 1986, three studies were assigned to be continued as part of this project. This permits more intensive laboratory and field evaluations and analyses of these studies, which would not have been possible otherwise. These studies are briefly discussed below along with highlights of results and future work plans.

STUDY 1: SUPPLEMENTAL POLLINATION OF LODGEPOLE PINE (EXPERIMENT G222)

This study was established in 1985 in a research seed orchard located at Pine Ridge Forest Nursery. The objective was to evaluate effectiveness of

supplemental or booster pollination technique in increasing seed yield of lodgepole pine in comparison to ordinary wind pollination. Eighteen six-year-old lodgepole pine trees were divided into two groups of nine trees each. One group was designated as 'control' and received wind borne pollen only to fertilize seed cone flowers. In addition to wind pollination, the second group of trees was also supplementally pollinated by hand with fresh pollen.

In 1986, as part of C.A.F.R.D.A. work, cones were collected from individual trees and separately extracted. Data were collected on (1) number of seeds per cone, (2) 1000 seed weight, and (3) seed germination. It was found that supplemental pollination substantially increased mean number of seeds per cone. Summary of results on the three variables studied is presented in Table 3.

TABLE 3
Seed production and seed quality of
lodgepole pine supplemental pollination study

Treatment Group	No. of Seeds Per Cone Mean + S.E.	1000-Seed Weight (g) Mean + S.E.	Germination (%) Mean + S.E.
Control	15.9 ± 3.2	4.60 ± .15	96.7 ± 0.9
Supplemental pollination	24.7 ± 2.8	4.27 ± .22	94.5 ± 1.0

STUDY 2: FLOWERING AND SEED PRODUCTION OF WHITE SPRUCE AND LODGEPOLE PINE IN "ACCELERATED GROWTH" SEEDLING SEED ORCHARD (EXPERIMENT G124)

This study was started in 1980 to learn about changes in flowering and seed production of white spruce and lodgepole pine with increasing age in a seedling seed orchard established at Pine Ridge Forest Nursery. In addition, the study is also evaluating effectiveness of "accelerated growth" (AG) treatment of planting stock in enhancing flowering and seed production in the two species. Each year data are recorded from individual trees on following traits: number of female strobili produced, number of male strobilus clusters produced, cone size and volume, seed yield and seed germinaion.

Starting in 1986, work on this study was transferred to C.A.F.R.D.A. project. At this time trees were seven years old and starting to produce sizeable flower and cone crops in lodgepole pine and considerable extra resources were needed to carry out the required investigations. As part of this work, data have been collected for two cone crop years (1986 and 1987). Flowering on white spruce so far has been sparse. However, lodgepole pine has started to flower profusely and very interesting and useful information is starting to emerge to assist seed orchards planning as part of Alberta tree improvement program. Some preliminary results on time trends in flowering of lodgepole pine and effectiveness of AG treatment in enhancing flowering in this species are shown in Figure 3. Future work plan for this study is to continue data collection in 1988 and 1989 and to summarize results in a scientific publication.

FIGURE 3 — FLOWERING SUMMARY OF LODGEPOLE PINE.

Figure 3a – Percentage of trees exhibiting flowering in two treatment groups (AG vs. control)[1] at different ages.

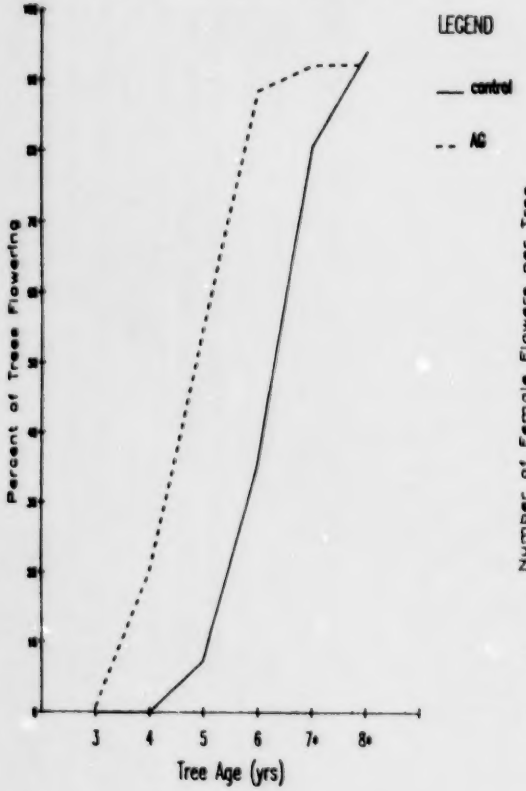


Figure 3b – Mean number of female strobili produced per tree in two treatment groups (AG vs. control)[1] at different ages.

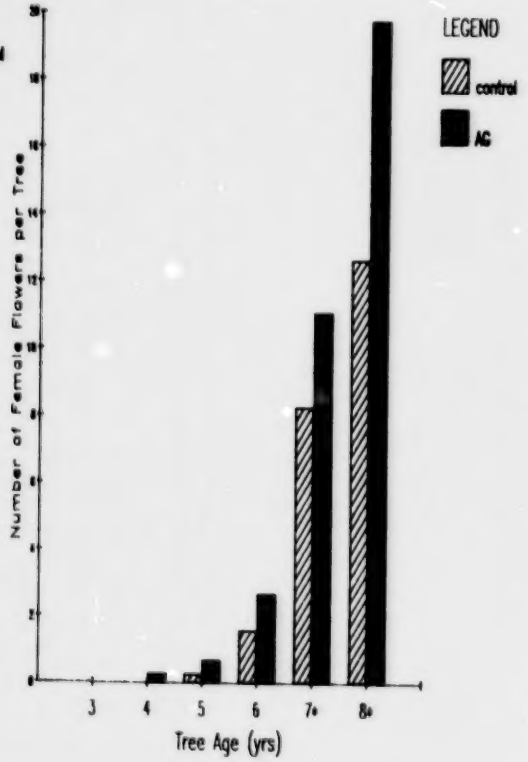
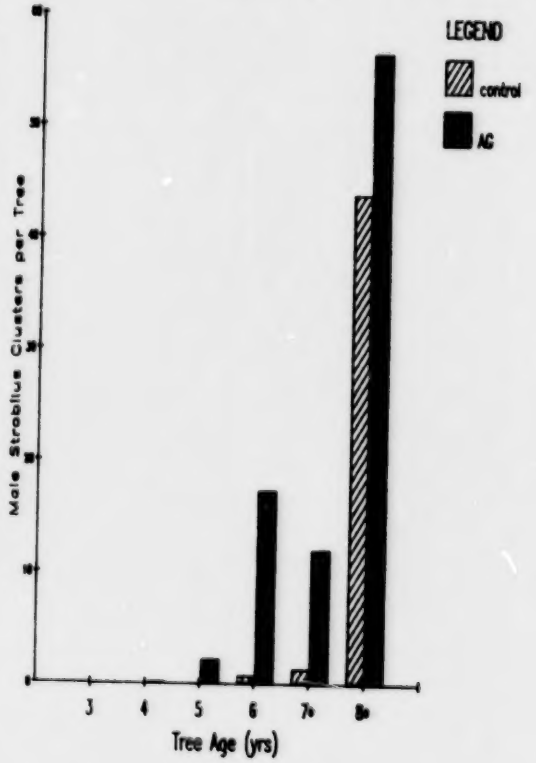


Figure 3c – Mean number of male strobilus clusters produced per tree in two treatment groups (AG vs. control)[1] at different ages.



[1] AG = planting stock grown under "accelerated growth" regime.

[1] control = planting stock grown under "standard" growing regime.

• – study years funded by C.A.F.R.D.A.

STUDY 3: EARLY FLOWERING AND SEED PRODUCTION OF WHITE SPRUCE GRAFTS AT FOUR LOCATIONS IN ALBERTA AND BRITISH COLUMBIA (EXPERIMENT G125)

This study was started in 1979 with a concern to find out the best location for establishing white spruce seed orchards as part of Aberta tree improvement progam, and to learn about flowering and seed production of this species in clonal seed orchard situation. The study involves yearly monitoring of flowering, cone production, seed yield and seed quality of white spruce grafts of northern Alberta origin established at four climatically diverse locations in Alberta and British Columbia. Grafts were made in 1979 and plantings were established in 1981 and 1982. The outplantings contained three or four grafts of 12-17 clones. Outplanting locations were: (1) a 'local' northern Alberta site at Grande Prairie, (2) a central Alberta site at Smoky Lake, (3) a southern Alberta site at Brooks, and (4) a south western British Columbia site at Vernon which is known for its warm climate.

Starting in 1986, work on this study was also transferred to C.A.F.R.D.A. project. At this time grafts were seven years old and had started to flower profusely. This permitted commencement of detailed investigations on cone and seed aspects of this study. Field and laboratory investigations have now been completed for 1986 and 1987. Each year information was compiled on individual grafts at each location for the following traits: number of male and female strobili produced, number of cones produced, seed yield, seed soundness and seed germination. Experimental data have been partially analysed and some selected results are presented in Tables 4 and 5 to illustrate the scope and significance of this work.

The results have provided insight into variation of flowering, cone production, seed yield and seed quality of white spruce clones from year to year and according to locations. Based on these findings, it can be concluded that significant cone production from white spruce clonal seed orchards in Alberta can be expected only seven years following grafting. The study also alleviated earlier concerns with regard to suitability of Pine Ridge Forest Nursery (Smoky Lake) and Grande Prairie site for establishing seed orchards. Future work plan for this study is to continue data collection and analyses in 1988 and 1989 and to summarize results in a technical report.

3.2.4 Demonstration Trials

A number of demonstration plantings are planned to be established at the "Genetics and Future Reforestation" site being developed as part of the Jumpingpound Demonstration Forest. It should be noted that the Jumpingpound Demonstration Forest is a separately funded C.A.F.R.D.A. project. The site for "Genetics and Future Reforestation" demonstrations is being developed by the Demonstration Forest project. However, once the area is ready in spring 1988, the plantings on this site are proposed to be established and maintained as part of C.A.F.R.D.A. tree improvement project.

Table 4. Summary of results on Flowering of white spruce grafts during 1983 - 1987 at four locations in Alberta and British Columbia.

Location	Average No. of Grafts Flowering per Year (%)	Mean No. of Strobili/Graft/Year	
		Female	Male
Vernon, B.C.	63.8	15.9	38.6
Brooks, Alberta	50.5	15.5	42.6
Smoky Lake, Alberta	37.6	18.5	16.8
Grande Prairie Alberta	44.6	20.0	6.1

Note: Only 1986 and 1987 work is covered by C.A.F.R.D.A.

Table 5. Cone production and seed characteristics of white spruce grafts in 1986 cone crop year at Grande Prairie, Alberta.

Clone Number	No. Living Grafts	Mean No. Cones/Graft	Mean No. Seeds/Cone	Mean Filled Seed (%)	Mean Germination (%)
X73	4	13.0	9.3	90.0	75.0
X76	2	5.5	0	--	--
X78	2	24.0	8.3	94.5	84.0
X80	4	157.8	2.6	95.1	91.1
X81	4	37.8	4.1	92.1	86.6
X82	3	109.7	6.7	96.6	90.8
X83	3	50.0	8.9	97.5	93.3
X84	1	183.0	5.7	96.0	85.5
X86	2	93.5	6.3	98.5	94.7
X90	2	53.5	10.7	93.2	87.7
X91	3	88.0	3.4	95.1	88.0
X92	4	47.3	2.5	83.2	87.1
Overall Mean	-	71.9	5.7	93.8	87.6

The objective of "Genetics and Future Reforestation" demonstration trials is to introduce the general public to the provincial genetics and tree improvement program and explain how it will contribute to improving yield and wood quality of the future forest. Selected aspects of genetics and tree improvement work will be demonstrated by establishing experimental plantings, and providing interpretive explanations on signs to be installed along the plantings. The following plantings are planned to be established at present:

-- Douglas-fir mini seed orchard
-- Native species trial arboretum
-- Promising exotic species demonstration
-- Seed source demonstration plantings of white spruce and lodgepole pine
-- Demonstration planting of different types of reforestation stock.

Stock production for these trials is already in progress and outplantings will be carried out during 1988 and 1989.

3.3 Survey and Evaluation of Rare and Exceptional Stands

The purpose of this activity is to survey the province for forest stands which are considered to be of rare and exceptional nature. Once these stands are identified, they are then documented and designated as gene pool reserves for long term conservation of genetic resources of species of forestry importance in Alberta.

This activity is a new function of the provincial genetics and tree improvement program and was commenced with the start of C.A.F.R.D.A. tree improvement project in 1986. Progress of work accomplished and future plans are described below.

3.3.1 Methodology

The project was started in the Slave Lake Forest in September 1986 with two out of the six ranger districts (DS-1 and DS-2) being completely surveyed by April 1987. An office survey for candidate stands was conducted for each of the ranger districts from AFFORISM data supplied by Timber Management Branch and suggestions by the Forest field staff. From this, over 80 stands were identified and visually inspected from the air or by ground. A short list was then compiled and 14 of the stands were chosen for a detailed field assessment. This consisted of ten white spruce stands, one tamarack stand, one black spruce stand, one jack pine and one lodgepole pine stand (Table 6). The actual survey process for cruising a candidate stand is quite intensive. Part of the purpose of work in the Slave Lake Forest was to "fine tune" the evaluation criteria for each of the parameters measured in the ground survey. Fifty-five plots are established on an equally spaced sampling grid and data relating to composition, stocking, basal area/hectare, ages, crown form, straightness and branching characteristics are measured at each plot.

3.3.2 Analysis of Stand Data

The data for each stand was then evaluated using a number of statistics. Criteria relating to overall stand composition, ratio of volume in dominant and co-dominant trees to overall stand volume, height-age ratios were all treated as havi-g a minimal acceptable level. Using this criteria, three of the ten white spruce stands were further scrutinized in terms of other attributes that would make them of a rare or exceptional nature. Two of these stands (SSW-01 and SSW-08 in Table 6) were identified as having exceptional characteristics. The four stands cruised, which were not white spruce, did not appear to have any particularly rare attributes, but will be carefully re-examined when the Slave Lake survey is completed next year.

3.3.3 Future Plans

Land reservations are currently in progress to protect the two exceptional white spruce stands already identified. The work is currently ongoing to complete the survey and evaluation of stands in the remainder of the Slave Lake Forest and is expected to be completed by April 1988. A significant part of the work completed by now was to refine the methodology and put into place a complete and working survey system for identifying rare and exceptional stands in Alberta. This was accomplished and now the project can be extended to the remaining nine Forests in the future depending upon the availability of resources.

3.4 Experimental Areas Development

The purpose of this activity is to develop and provide additonal experimental areas for establishment of seed orchards, research plantings and germplasm banks for the expanded provincial genetics and tree improvement program. Prior to the commencement of C.A.F.R.D.A. Tree Improvement project, a network of 22 genetics and tree improvemental experimental areas, spread throughout the province, was already developed. This network is being further expanded to provide additional sites for current and future needs of the provincial tree improvement program.

Seven new experimental areas developments are being undertaken with the assistance of C.A.F.R.D.A. funding. A brief description of the location of each site, site work completed with C.A.F.R.D.A. funding and future work plan to complete site development is given below.

3.4.1 Wandering River Experimental Area

- The site is located in the Lac La Biche Forest adjoining Wandering River Ranger District
- Geographic location is:
  - Latitude: 55°12' N
  - Longitude: 112°30' W
  - Elevation: 567 m
  - Legal description is SE 2-72-17-W4M

Table 6: Listing and description of 14 stands evaluated in 1987/88 as part of Rare and Exceptional Stands Survey project in the Slave Lake Forest

Stand Code For Project	Phase III Stand No.(s)	Size (Ha)	Stand Description (s)*	Remarks
SSW-01	118 and 119	27.4	C3 Sw	100% Sw; 48% dominant or co-dominant; exceptional
SSW-02	69, 136 and 133		C4 Sw A-L	68% Sw; low # stems/ha
SSW-03	128, 129	41.6	C3 Sw A-L C3 A Sw-L	68% Sw; low ratio of dominant trees
SSW-04	160	34.1	C3 Aw Sw-L-90 M	59% Sw; large aspen component
SSW-05	168 (part A)	26.9	C3 Sw (Aw)-L	68% Sw; poor ht/age
SSW-06	80 + 198 (part A)	65.0	C3 Sw Aw-L C4 Sw (Aw)-L	59% Sw; large aspen and balsam component
SSW-07	167	95.0	C4 Sw Aw-L 86-6	60% Sw; large aspen and balsam component
SSW-08	35 + 14	57.5	C3 Sw Aw-L C4 Sw Aw-L	81%; good branch angle, good ht/age; exceptional
SSB-01	158		D2 Sw Sb-R	90% Sb; poor ht/age
SSW-09	85	22.7	C3 SwA-R	56% Sw; poor ht/age
SPJ-01	194	13.0	C2P(Sb)-U-92-M	95% Pj; good attributes; wait for other comparison Pj (very young)
SSW-10	151 + 253	33.0	D2Sw-R-92-M C2S+(A)-R-92-M	94% Sw; very young ($\bar{x}$ age = 51)
SPL-01	43 + 47	31.7	D3P-L-90 M C3PSw-L-90 M	71% Pl; poor form; average ht/age ratio
SLT-01	392	15.2	C2 LT	87% Lt; poor ht/age, ratio; poor ht.

- -- Net area being developed is approximately 12 hectares
- -- Work carried out on the site was as follows:
  - -- Slash piles burned and disposed off on already partially developed site
  - -- Land breaking, rock picking and root raking completed
  - -- Site was plowed, fertilized and seeded with fall rye; discing-in fall rye completed
- -- Remaining work to be completed in 1988/89 consists of installing trickle irrigation on a part of the site
- -- The site will be fully ready for planting commencing summer 1988

3.4.2 Whitecourt Mountain Experimental Area

- -- The site is located in the Whitecourt Forest near the town of Whitecourt
- -- Geographic location is:
  - -- Latitude: 54°04' N
  - -- Longitude: 115°47' W
  - -- Elevation: 800 m
  - -- Legal description is SE 36-58-13-W5M
- -- Net area begin developed is approximately 11 hectares
- -- Work carried out on the site was as follows:
  - -- Slash piles repiled and reburned on already partially developed site
  - -- Site rotovated
  - -- Access trail and dugout put in
- -- Remaining work to be completed in 1988/89 consists of:
  - -- Improve dugout
  - -- Discing and cross-discing
  - -- Install chain link fence to protect site from trespass and wildlife damage
- -- The site will be fully ready for planting commencing spring 1989

3.4.3 Diamond Hill Experimental Area

- -- The site is located in the Rocky/Clearwater Forest in Diamond Hill reserve
- -- Geographic location is:
  - -- Latitude: 52°37' N
  - -- Longitude: 115°05' W
  - -- Elevation: 991 m
  - -- Legal description is parts of N 1/2 Sec 16-42-8-W5M
- -- Net area being developed is approximately 10 hectares
- -- Work carried out on the site was as follows:
  - -- Repile and reburn slash on already partially developed site
  - -- Discing and cross-discing
- -- Remaining work to be completed in 1988/89 consists of:
  - -- Repile and reburn residual slash
  - -- Disc site and clear fence line
  - -- Install chain link fence to protect site from trespass and wildlife damage
- -- The site will be fully ready for planting commencing spring 1989.

3.4.4 Tershishner Creek Experimental Area

- The site is located in the Rocky/Clearwater Forest near Nordegg
- Geographic location is:
  - Latitude: 52°21' N
  - Longitude: 116°23' W
  - Elevation: 1500 m
  - Legal description is LS 1-10-39-17-W5M
- Net area being developed is 2.5 hectares
- Work carried out on the site was as follows:
  - Site clearing, slash piling and burning slash piles
  - Discing and cross discing
  - Installation of chain link fence to protect site from trespass and wildlife damage
- Remaining work to be completed in 1988/89 consists of discing site once more
- The site will be ready for planting commencing spring 1989.

3.4.5 Bateman Creek Experimental Area

- The site is located in the Bow/Crow Forest near the Jumpingpound Demonstration Forest site
- Geographic location is:
  - Latitude: 51°03' N
  - Longitude: 114°49' W
  - Elevation: 1448 m
  - Legal description is SE 1/4 LS 14-24-6-W5M
- Net area being developed is approximately two hectares
- Work carried out on the site was as follows:
  - Slash piling and burning slash piles on already cleared site
  - Discing and cross discing
  - Installation of fence posts to complete barbed wire fence to protect site from cattle trespass
- Remaining work to be completed in 1988/89 consists of:
  - Disc site once more
  - Complete barbed wire fence
- The site will be ready for planting commencing in summer 1988.

3.4.6 Porcupine Hills Experimental Area

- The site is located in the Bow/Crow Forest in Porcupine Hills reserve
- Geographic location is:
  - Latitude: 49°51' N
  - Longitude: 114°20' W
  - Elevation: 1830 m
  - Legal description is E 1/2 LS 14-36-10-1-W5M
- net area being developed is approximately 1.5 hectares
- Work carried out on the site was as follows:
  - Clearing site, slash piling and burning slash piles
  - Land breaking, stumping and discing site
  - Installation of barbed wire fence to protect site from cattle trespass

-- Remaining work to be completed in 1988/89 consists of discing the site once more
-- The site will be ready for planting commencing summer 1988.

3.4.7 Castle River Experimental Area

-- The site is located in the Bow/Crow Forest near Blairmore, adjacent to an already established genetics and tree improvement experimental area
-- Geographic location is:
  -- Latitude: 49°20' N
  -- Longitude: 114°20' W
  -- Elevation: 1350 m
  -- Legal description is LS 1-22-5-3-W5M
-- Net area being developed is 1.8 hectares
-- Work carried out on the site was as follows:
  -- Clearing site, slash piling and burning slash piles
  -- Land breaking and discing site
  -- Installation of barbed wire fence to protect site from cattle trspass
-- Remaining work to be completed in 1988/89 consists of discing site once more
-- The site will be ready for planting commencing summer 1988.

In addition to the new experimental areas developments, C.A.F.R.D.A. funds are also used for minor site improvement work on existing genetics and tree improvement experimental areas. The work carried out in this regard consisted of fence repairs and backfilling along fence lines at Fox Creek and Carson Lake Experimental Areas. Minor site improvements are also planned to be carried out at several other sites during 1988 and 1989.

3.5 Plant Propagation, Seed Technology and Technical Support

The purpose of this activity is to carry out an increased production program at Genetics Section, Pine Ridge Forest Nursery in support of the expanded portion of genetics and tree improvement program due to C.A.F.R.D.A. In addition, increased technical assistance and EDP support is provided as per requirements of the expanded program. The work completed during the report period was as follows:

-- 930 white spruce and 40 Douglas-fir grafts were made
-- 1700 white spruce and 300 Douglas-fir rootstock trees were potted for grafting program
-- Tending and maintenance was carried out on new grafts as well as on grafts already established in holding areas and clone banks
-- 374 seedlots were extracted and processed; 112 seedlots were germination tested
-- Wood specific gravity analyses were completed on wood samples collected from 30 white spruce and 10 Douglas-fir trees; fibre length analyses were completed on wood samples collected from 30 white spruce trees

-- Field layout maps and drafting was carried out for applicable project reports
-- Experimental data collected from research studies being carried out under C.A.F.R.D.A. were compiled and necessary statistical analyses completed.

To meet the data management and statistical analyses needs of the expanded genetics and tree improvement program the following computer hardware and software was acquired with C.A.F.R.D.A. funds:

Hardware:

-- IBM/PC-AT Model 339 micro-computer (with expansion board to bring memory to 1 Mbyte; 1 x 360K diskette; 1 x 1.2 Mbyte diskette; internal 30 Mbyte fast access hard disc)
-- Sysdyne amber monochrome monitor
-- Hercules graphics card
-- 60286 math coprocessor chip
-- Epson FX-286 printer
-- UPS unit

Software:

-- SPSS/PC (statistics package)
-- Smart (word processing, data base management, communications, spread sheet integrated package)
-- Sideways (prints spread sheets sideways)
-- DOS 3.2

In addition, several pieces of specialized equipment were purchased to assist the expanded genetics program at Pine Ridge Forest Nursery. These include:

-- 30" hydraulic tree spade to be used to rogue seed orchards and consolidate remaining trees. Also to create artificial drought stress in flowering and seed production studies.
-- biophenometer (growing degree day and chilling hour accumulator) to be used to develop the relationships between growing degree days and flowering and chilling hours and plant dormancy.

Future work plan for plant propagation, seed technology and technical support activity functions for the remaining duration of C.A.F.R.D.A. is to continue increased program at similar levels as described for the current report period.

4.0 CONCLUSION

The Canada-Alberta Forest Resource Development Agreement Funding is assisting in accomplishment of substantial amount of additional work on the provincial genetics and tree improvement program than would have been possible with A.F.S. resources. This is facilitating more rapid development of improved strains of tree seed and seed orchards to mass produce genetically superior seed for reforestation. Research efforts have also been intensified to develop much needed new information and technology for practical tree improvement in Alberta. Field demonstrations are being established to explain tree improvement program to general public. All this is greatly assisting in Alberta's efforts to enhance timber yield and quality of the future forest, and to realize these benefits starting at an earlier date.